

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Appl. No. : 10/576,033  
Applicant : Milliren, Charles M.  
Filed : April 14, 2006  
Title : VISCOELASTIC FOAM LAYER AND COMPOSITION

Conf. No. : 9700  
Art Unit : 1796  
Examiner : Cooney, John M.

Customer No. : 00116  
Docket No. : INTF-36211US1

**APPEAL BRIEF**

This brief is filed pursuant to the Notice of Appeal filed August 10, 2010. The two-month period for filing this brief pursuant to 37 CFR § 41.37(a)(1) expired on October 10, 2010. Accordingly, please charge the two-month extension-of-time fee of \$245 and the appeal brief fee of \$270 under 37 CFR § 41.20(b)(2) to our Deposit Account No. 16-0820, Order No. INTF-36211US1. If there are any additional fees resulting from this communication, please charge same to our Deposit Account No. 16-0820, our Order No. INTF-36211US1.

**REAL PARTY IN INTEREST**

The real party in interest in the subject proceeding is Intellectual Property Holdings, LLC.

**RELATED APPEALS AND INTERFERENCES**

There are no known related appeals or interferences that may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

#### **STATUS OF CLAIMS**

Claims 35-37, 39-48 and 51-68 in the proceeding stand rejected and are being appealed.

Claims 1-34, 38 and 49-50 stand canceled.

**STATUS OF AMENDMENTS**

No amendments to the claims have been filed subsequent to the final rejection.

## SUMMARY OF CLAIMED SUBJECT MATTER

### Claim 35:

A semi-rigid viscoelastic foam made from a Part A composition and a Part B composition (p. 2, ll. 22-23; p. 11, ll. 23-27), said Part A composition comprising 20-50 weight percent isocyanate (NCO) (p. 2, ll. 23), said Part B composition comprising at least 40 parts by weight of one or a mixture of propylene oxide-extended amine-based polyether polyols (p. 4, ll. 19-21; p. 5, Table 1) being at least 3-functional and having an OH number less than or about 150 (p. 6, ll. 5-6) and having-substantially no ethylene oxide extension units (p. 2, ll. 26-27; p. 6, ll. 22-24), at least 10 parts by weight of an additional polyol selected from the group consisting of non-amine filled polyether polyols and non-amine unfilled polyether polyols (p. 2, ll. 27-28; p. 11, ll. 29-30), and 0.01-4 parts by weight catalyst (p. 2, ll. 28-29), said Part A and Part B compositions being combined to provide said viscoelastic foam, wherein all values expressed as weight percents are based on the total weight of the Part A composition, and all parts by weight are parts by weight of the Part B composition, said Part B composition having 100 parts by weight total polyols (p. 4, ll. 25-35).

### Claim 54:

A method of making a semi-rigid viscoelastic foam comprising the steps of:

- a) providing a Part A composition comprising 20-50 weight percent isocyanate (p. 3, ll. 4-5; p. 11, ll. 23-27);
- b) providing a Part B composition comprising at least 40 parts by weight of one or a mixture of propylene oxide-extended amine-based polyether polyols (p. 4, ll. 19-21; p. 5, Table 1) being at least 3-functional and having an OH number less than or about 150 (p. 6, ll. 5-6) and

having substantially no ethylene oxide extension units (p. 2, ll. 26-27; p. 6, ll. 22-24), at least 10 parts by weight of an additional polyol selected from the group consisting of non-amine filled polyether polyols and non-amine\_unfilled polyether polyols (p. 3, ll. 8-9; p. 11, ll. 29-30), and 0.01-4 parts by weight catalyst (p. 3, ll. 9-10); and

c) combining said Part A and Part B compositions to provide said semi-rigid viscoelastic foam (p. 3, ll. 10-11; p. 11, ll. 23-27);

wherein all values expressed as weight percents are based on the total weight of the Part A composition, and all parts by weight are parts by weight of the Part B composition, said Part B composition having 100 parts by weight total polyols (p. 4, ll. 25-35).

Claim 66:

A foam, said foam being a semi-rigid viscoelastic foam (p. 11, ll. 23-27), wherein on impact with a flat circular impactor having a 4-inch diameter (p. 15, ll. 24-25) at an impact speed of 2 meters per second (p. 15, ll. 31-33), a sample of said foam measuring 5.5" x 5.5" x 1" thick (p. 15, ll. 23-24) exhibits about 100 g's of breakthrough acceleration (Figure 1), and wherein said foam sample is substantially 100% recoverable following said 2 m/s impact (p. 15, ll. 27-30; p. 16, ll. 1-2; Figure 1).

Claim 68:

A viscoelastic foam made from a Part A composition and a Part B composition (p. 2, ll. 22-23), said Part A composition comprising 20-50 weight percent isocyanate (NCO) (p. 2, ll. 23), said Part B composition comprising at least 40 parts by weight of propylene oxide-extended triethanolamine-based polyether polyol (p. 4, ll. 19-21; p. 5, Table 1; p. 5, [0021]) having an OH

number less than or about 150 (p. 6, ll. 5-6) and having substantially no ethylene oxide extension units (p. 2, ll. 26-27; p. 6, ll. 22-24), at least 10 parts by weight of an additional polyol selected from the group consisting of non-amine filled polyether polyols and non-amine unfilled polyether polyols (p. 2, ll. 27-28; p. 11, ll. 29-30), and 0.01-4 parts by weight catalyst (p. 2, ll. 28-29), said Part A and Part B compositions being combined to provide said viscoelastic foam, wherein all values expressed as weight percents are based on the total weight of the Part A composition, and all parts by weight are parts by weight of the Part B composition, said Part B composition having 100 parts by weight total polyols (p. 4, ll. 25-35).



**GROUND OF REJECTION TO BE REVIEWED ON APPEAL**

35 U.S.C. §103(a)

Claims 35-37, 39-48 and 51-68 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Apichatachutapan et al. (hereinafter “Api”) (US 2004/0266897).

35 U.S.C. § 112

Claims 66-67 stand rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement.

## ARGUMENT

### ***A. Claims 35-37, 39-48 and 51-68 are patentable over Api***

Applicant submits that claims 35-37, 39-48 and 51-68 are not rendered obvious over the cited Api reference. As discussed below, independent claim 35 is being argued as the representative claim for the group of claims including 36-37, 39-48, 53-54 and 55-65, all of which are dependent claims except for independent claim 54 which claims a method of making the foam of claim 35. Dependent claims 51 and 52, which depend directly or indirectly from claim 35, are argued separately. Independent claim 66 is being argued as the representative claim for claim 67, which depends directly from claim 66. Lastly, independent claim 68 is argued separately.

#### ***Independent Claim 35***

The basic building blocks of polyurethane foams are isocyanate and one or more polyols or types thereof. These broad chemical classes, together with catalysts, blowing agents and additives, generally represent all polyurethane foam compositions. The knowledge of these classes, and that each class includes a vast number of possible components, does not render obvious any particular polyurethane foam or the claimed foam. That is, even if a reference happens to disclose the components of a particular foam as members of vast lists for each class of components that go into polyurethane foams, to render that foam obvious there also must be a suggestion or motivation to combine the specific components from the respective lists to arrive at the specific (e.g., claimed) foam. See *In re Kotzab*, 217 F.3d 1365, (Fed. Cir. 2000).

**1. Api does not provide a predictable solution or expectation of success to prepare a semi-rigid, viscoelastic and recoverable polyurethane foam**

The chemical arts are unpredictable, and thus specific solutions described in the prior art are less likely to render alternative solutions genuinely predictable. *Eisai Co. Ltd. v. Dr. Reddy's Laboratories, Ltd.*, 533 F.3d 1353, 1359 (Fed. Cir. 2008), citing *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, (2007). Predictability requires the expectation that prior art elements are not only capable of being combined, but that the combination is expected to work for its desired purpose. *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314 (Fed. Cir. 2009).

Among all the possible polyurethane foam compositions, Api is specifically directed to *flexible, flame-retardant* polyurethane foams (see background section and whole patent). Api's foam is made with 2 (optionally 3) isocyanate-reactive components (see para. [0020]). Api broadly discloses that each reactive component can be selected from large groups, such as the general classes of polyols, polyamines and polyesters, but also at the same time acknowledges that making viscoelastic foam hinges on finding the right mixture of polyether polyols and other components (see para. [0010]). Api clearly appreciates that the art of foams is unpredictable. Api also discloses that by modifying the amounts of the first, second and third reactive components, the flame retardant foam therein can be made (see para. [0031]). This further shows that Api recognizes that not only do the specific components need to be selected from among the vast number of potential ingredient combinations, but that the amount of each component also needs to be adjusted to prepare Api's foam.

Thus, it is clear that even though Api provides a laundry list of all possible components for polyurethane foams, the proper selection of such components, and in the proper amounts, is critical when forming Api's *flexible, flame-retardant* foam. It is similarly critical when

formulating the presently-claimed foams. Laundry listing all the possible components that might be combined to make a foam does not teach or suggest to a skilled artisan how to select particular subsets of the listed components and classes thereof (and to combine them in proper amounts) to arrive at the claimed semi-rigid foam. Api provides no guidance how to prepare a semi-rigid viscoelastic foam or how to combine the endless lists of possible components to arrive at the claimed foam, which only invites undue experimentation with no clear target. Nor does Api provide any identifiable, predictable solution as to how to prepare the claimed semi-rigid foam. Rather, as noted above, Api acknowledges the unpredictable nature of the chemical arts, which fairly suggests that the claimed semi-rigid foam is not likely to be genuinely predictable, especially from a reference that is directed to flexible foams.

Api also fails to provide any reasonable expectation to one skilled in the art that its large lists of various classes of components, which can be combined to produce thousands (or more) of possible chemical compounds, can be combined as claimed, or that any resulting foam would work for the intended purpose – impact force attenuation (see para. [0001] of the instant application). Api only teaches one skilled in the art that its own foams are flexible and flame retardant. One skilled in the art is not provided with any teaching from Api that would lead to the selection of components that would produce a semi-rigid viscoelastic foam as claimed (e.g., requiring at least 40 weight percent of one or a mixture of propylene oxide-extended amine-based polyether polyols being at least 3-functional and having an OH number less than or about 150 and having substantially no ethylene oxide (“EO”) extension units) or that such a foam would exhibit desirable impact force attenuation properties. In fact, Api does not even present these as goals for a foam, much less explain how to make one. In contrast, as discussed in the inventor’s previously-filed declaration (Declaration of Charles M. Milliren, Ph.D., submitted as

evidence herewith), the claimed foam was surprising and unexpected, and because Api is directed to flexible foams, one skilled in the art would not expect to produce a semi-rigid foam as claimed. The contents of Dr. Milliren's declaration are discussed directly below.

With regard to flexible foams, Dr. Milliren states that the foams of Api are soft, flexible foams, not semi-rigid foams, as evidenced by the data presented in Api's examples (p. 3, statement 12). For instance, Api's foams were tested for IFD and sag factor, whereas semi-rigid foams as claimed could not be tested for IFD or sag at least because they are too rigid to fall within the property limits of soft flexible foams (p. 3, statement 12). Conversely, the present application presents extensive data for the claimed semi-rigid foams showing energy absorption characteristics at various dynamic impact speeds, which testing is totally unsuitable for flexible foams as in Api because such foams do not exhibit any appreciable degree of dynamic impact energy attenuation and would be instantaneously compressed (p. 3, statement 12). Clearly, not only would one skilled in the art not turn to Api for a teaching on foams exhibiting dynamic impact energy attenuation, but Api is directed to soft, flexible foams that do not exhibit the properties of the claimed foam.

With regard to the unexpected and surprising results of the claimed foam, Dr. Milliren states that based on his 30 plus years of professional research and development experience, each component that goes into a polyurethane foam composition can affect the characteristics of the final foam in an unpredictable way based on its effect on the foam's morphology and physico-chemical structure, which cannot be specified *a priori* (p. 2, statement 9). Similarly, Api explicitly discloses that making viscoelastic foam hinges on finding the right mixture of polyether polyols and other components (see para. [0010]). Thus, the inventor and the cited reference agree that finding the right mixture of components to produce a foam with desired

properties is not a predictable exercise. In the case of the claimed foam, it was particularly surprising that an amine-based polyol having substantially no EO units would produce such an effective semi-rigid and recoverable viscoelastic polyurethane foam.

Amine-based initiators result in highly reactive polyols, which produce foams with high degrees of cross-linking compared to foams produced using polyols based on other initiators, e.g., glycerin (Declaration p. 9, Statement 24). Higher cross-linking rates typically result in much stiffer, more rigid foams as known in the art (Declaration p. 9, Statement 24). Regarding extension units, EO extension is usually employed to provide flexibility, whereas propylene oxide ("PO") extension tends to decrease foam flexibility (increase rigidity) (Declaration p. 2, statement 9). Thus, it would not be predictable to one skilled in the art to end up with a polyurethane foam made from at least 40 parts by weight of an amine-based polyether polyol having substantially no EO units that is viscoelastic and fully recoverable. Rather, the high reactivity and lack of EO extension would lead one to expect a fully-rigid and unrecoverable foam. A person of ordinary skill in the art would have no expectation of success to achieve the recoverable semi-rigid viscoelastic foam as claimed.

**2. Api teaches away from preparing a semi-rigid, viscoelastic and recoverable polyurethane foam comprised of EO-free propylene oxide-extended amine-based polyether polyols**

All 6 examples of Api have at least 60 weight percent of a glycol-based polyol (PLURACOL<sup>®</sup> 593) with 75% EO extension, which results in a soft, flexible foam as one may expect. As will be clear below, Api not only fails to provide one skilled in the art with a predictable solution or an expectation of success to produce a semi-rigid, recoverable and viscoelastic foam as claimed, but Api teaches away from the claimed composition, which

specifically requires at least 40 weight percent of one or a mixture of propylene oxide-extended amine-based polyether polyols being at least 3-functional and having an OH number less than or about 150 and having substantially no EO extension units.

An inference that a claimed combination would not have been obvious is especially strong if a reference's teaching undermines the exact reason being argued as to why a person of ordinary skill would have combined the elements. *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314 (Fed. Cir. 2009). Further, a claimed combination of components may not be obvious when the prior art teaches away from the claimed combination and the combination yields more than predictable results. *Crocs, Inc. v. U.S. Int'l Trade Comm'n.*, 598 F.3d 1294 (Fed. Cir. 2010).

Api provides 6 examples of flexible flame-retardant foams, and 1 comparative example. Notably, the foam of comparative example 1 is not flame retardant and is the only example to use an amine-based polyol (i.e. PLURACOL<sup>®</sup> 355) (see BASF's polyol product list in Evidence, which shows PLURACOL<sup>®</sup> 355 is amine-based). In other words, the only example in Api that uses an amine-based polyol did not achieve Api's objective of a flame retardant foam. Examples 1-6 do not use an amine-based polyol, especially one that is EO free (see para. [0042] of Api and BASF's polyol product list in Evidence section). The EO-free polyol used in Examples 1-6 was glycol-based and in an amount not greater than 40 wt% (i.e. PLURACOL<sup>®</sup> 726). Thus, Api does not fairly teach using at least 40 wt % of an amine-based polyether polyol with no EO as claimed. Indeed, the only time an amine-based polyol was used at all, it did not result in Api's target flexible, flame-retardant foam. The non-flame retardant (i.e., unsuccessful) foam in Api's comparative example not only contradicts Api's broad disclosure of amine-based polyols as candidates for one of the 2 (optionally 3) isocyanate-reactive components in that foam, but Api

specifically instructs that the comparative foam may have failed because of the presence of an amine-based polyol, whereas the successful examples did not use an amine-based polyol (see para. [0046]). It is not seen, therefore, how Api's overly-broad disclosure can be fairly relied upon to suggest a combination to arrive at the presently-claimed foam, when all of its embraced compositions do not even work for Api's intended purpose. Such a suggestion is even less appropriate considering the claimed foams differ in significant respects from that described by Api.

**3. Api's examples undermine its broad teaching such that Api does not fully teach or fairly suggest all ingredient combinations encompassed by its disclosure**

The Examiner contends that Api's examples do not derogate from what is fully taught or fairly suggested by the entire disclosure. This is true. But the Examiner is unfairly applying Api to argue that it suggests combinations of ingredients that it clearly does not, as evidenced in the examples. That is, Api's disclosure broadly states that virtually all initiators, polyols, extension units [EO or PO], catalysts, etc. can be used to make the target flame retardant flexible foam therein. Yet Api's own comparative example using an amine-based polyol within Api's broad disclosures demonstrates this is not the case. Even though the comparative example used 90 weight percent of the first isocyanate-reactive component, as opposed to Api's suggested range of 40-75 weight percent, Api clearly states that all three isocyanate-reactive components can be selected from the same group, and thus each component could be the same polyol and result in the foam having greater than 90 weight percent of one particular polyol. Api clearly attempts to disclose all possible combinations of polyols and other ingredients that can encompass any polyurethane foam. However, if Api's broad disclosure does not fairly suggest how to make even Api's own target foam using all of the disclosed ingredient combinations embraced by its



specification, it cannot possibly suggest making a foam having entirely different properties based on randomly combining those ingredients.

Considering that Api broadly discloses amine-based polyols but the only example using an amine-based polyol failed, and also that Api specifically acknowledges that successful examples did not use an amine-based polyol and even attributes their success to that fact, it cannot be the case that Api fairly suggests using at least 40 wt% of an 3-functional amine-based polyether polyol having substantially no EO extension as claimed, especially to produce a semi-rigid foam unlike anything described in that reference. Api is not limited to its examples. But when a reference clearly shows and acknowledges that a component (i.e. amine-based polyol) fails, that fact must take away from a reference's broad disclosure, and in particular from Api's laundry listing of components.

#### **4. Conclusion**

In view of the foregoing, a skilled artisan, in view of Api, would not think to use 1) amine-based polyols in the claimed amounts that 2) have substantially no EO extension and 3) that are at least tri-functional in order to prepare the foams taught in Api. Moreover, starting with Api, a skilled artisan also would not have been motivated, nor would he have expected to achieve a successful result, to prepare a semi-rigid viscoelastic foam from a polyol composition comprising amounts of amine-based polyether polyol as claimed. Accordingly, in view of the foregoing, applicant respectfully requests that the obviousness rejection of claim 35 be reversed.

#### ***Dependent Claim 51***

Claim 51 depends directly from claim 35, and further requires that the claimed one or a mixture of propylene oxide-extended amine-based polyether polyols comprise triethanolamine-

based polyol in an amount of 60 or 70 parts by weight, wherein parts by weight are parts by weight of the Part B composition, and the Part B composition has 100 parts by weight total polyols.

As noted above, of the 2 (optionally 3) isocyanate-reactive components of Api's foam, Api expressly teaches that only the second and optional third components can be EO-free. The first reactive component present at 40-75 weight percent must contain at least 60 parts by weight of EO extension (para. [0024]). The second component can be present at 25-60 weight percent, and the optional third component can be present at 20 to 45 weight percent. To arrive at the claimed foam, one skilled in the art, in view of Api's 3 reactive components, would need to select the lowest amount (40 wt%) of the first component having EO extension and the highest amount (60 wt %) of the second component, and further select an EO-free triethanolamine-based polyol as the second component, or alternatively, select a combination of the second and third components that yield at least 60 weight percent material of EO-free triethanolamine-based polyol.

Of the thousands of possible combinations of components, and the fact that each component is selected from the same broad groups that includes any polyol, polyamine and polyester, the applicant submits that such a selection to arrive at the claimed foam is not obvious. Not only can combinations selected from Api's own laundry list and meeting its own requirements for the 3 reactive components fail to produce Api's target flame-retardant foams (i.e. comparative example 1), but Api does not fairly suggest the claimed foam because it is directed specifically to flexible foams and even teaches away from using an amine-based polyol (i.e. that used in the failed comparative example). Similarly as for claim 35 above, Api does not teach the semi-rigid foam of claim 51 because it does not provide any encouragement to embark

on an expedition to select from among its lists of components to make a semi-rigid, viscoelastic and recoverable foam, nor does it inform someone wanting to try how he might select the appropriate components. Thus, one skilled in the art would not have an expectation of success for making the claimed foam. Accordingly, in view of the foregoing, applicant respectfully requests that the obviousness rejection of claim 51 be reversed.

***Dependent Claim 52***

Claim 52 depends directly from claim 51, and further requires that the one or mixture of propylene oxide-extended amine-based polyether polyols comprise monoethanolamine-based polyol in an amount of 8-10 parts by weight. Thus, the foam composition of claim 52 must include 60-70 parts by weight of a triethanolamine-based polyol and 8-10 parts by weight of a monoethanolamine-based polyol.

For at least the reasons discussed above with regard to claims 35 and 51, Api does not fairly suggest or create an expectation of success for a skilled artisan to select the claimed monoethanolamine- and triethanolamine-based polyols in the respective parts by weight for making a semi-rigid, viscoelastic and recoverable foam as claimed. Rather, Api teaches that amine-based polyols do not result in a flexible, flame retardant foam. In stark contrast, the semi-rigid, viscoelastic and recoverable foam of claim 52 requires at least two specific amine-based polyols in specific amounts. Because one skilled in the art would not have an expectation of success for making the claimed foam, the applicant respectfully requests that the obviousness rejection of claim 52 be reversed.

### ***Independent Claim 66***

The present rejection states that Api's preparations exhibit impact and strength properties which are not seen to differentiate from those claimed based on the materials and make-ups of the preparations claimed. Further, it is stated that because Api recites amine initiators, it would have been obvious for one skilled in the art to arrive at the claimed foam with the expectation of success.

Even if a reference variously discloses the elements of a claimed combination, there also must be a suggestion or motivation to combine these elements to arrive at the claimed invention. *See In re Kotzab*, 217 F.3d 1365, 1369-1370 (Fed. Cir. 2000) Moreover, because the chemical arts are unpredictable, one composition in the prior art that solves one problem is less likely to render genuinely predictable potential solutions for solving a different problem. *Eisai Co. Ltd. v. Dr. Reddy's Laboratories, Ltd.*, 533 F.3d 1353, 1359 (Fed. Cir. 2008), citing *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, (2007).

As noted above with regard to claim 35, Api does not teach or fairly suggest a semi-rigid viscoelastic foam that is 100% recoverable. To say that Api's preparations (which are disclosed broadly enough to encompass an indefinite number of combinations and thus will encompass foams with an endless number of different properties) exhibit the claimed impact and strength properties of the foam of claim 66 completely disregards the thrust of Api's invention and mischaracterizes its fair teaching.

Api fairly teaches and suggests to one skilled in the art how to make flexible flame-retardant foams. Evidence of this is clear in that Api's exemplary soft, flexible, flame-retardant foams were tested for IFD and sag factor (common for flexible foams), whereas the semi-rigid

foam as claimed could not be tested for IFD or sag at least because it is too rigid to fall within the property limits for these tests (Declaration p. 3, statement 12). In contrast, the claimed semi-rigid viscoelastic foam of claim 66 was measured for energy absorption characteristics at various dynamic impact speeds, which testing is totally unsuitable for flexible foams because such foams do not exhibit any appreciable degree of dynamic impact energy attenuation and would be instantaneously compressed, i.e. bottomed out (Declaration p. 3, statement 12).

One skilled in the art, considering the vast number of possible combinations of components that Api discloses, without guidance as to what actually works even for Api's purpose, could not predict or expect success for any specific combination that may result in a foam suited to a different purpose, namely a semi-rigid, viscoelastic and recoverable foam. As noted above, the only guidance Api provides to one skilled in the art is in its examples, which by way of the comparative example show that even combinations falling within its broad disclosure fail to work for Api's own intended purpose. Api does not disclose or show an example foam composition having the claimed foam's strength and recoverability properties. Instead, Api's laundry listing of nearly all possible components of polyurethane foams is being relied on to suggest that the claimed foam is obvious. Without some guidance, suggestion or motivation to pick or choose among Api's broad disclosure, with an expectation of success, Api cannot render the claimed foam obvious. Because Api fails to provide guidance to one skilled in the art of a foam possessing the claimed properties, Api does not render the claimed foam obvious, and thus applicant respectfully requests that the obviousness rejection of claim 66 be reversed.

### ***Independent Claim 68***

Claim 68 is similar to claim 35 except that claim 68 does not recite “semi-rigid” and claim 68 requires at least 40 parts by weight of PO-extended *triethanolamine*-based polyether polyol having an OH number less than or about 150 and having substantially no EO extension units.

As noted above, even though Api provides a laundry list of all possible components for polyurethane viscoelastic foams, the proper selection of such components, and in the proper amounts, is critical when forming Api’s flexible, flame-retardant foam. Such laundry listing does not teach or suggest to a skilled artisan how to select particular subsets of the listed components and classes thereof to arrive at the claimed foam. In fact, an inference that a claimed combination would not have been obvious is especially strong if a reference’s teaching undermines the exact reason being argued as to why a person of ordinary skill would have combined the elements. *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314 (Fed. Cir. 2009). Further, a claimed combination of components may not be obvious when the prior art teaches away from the claimed combination and the combination yields more than predictable results. *Crocs, Inc. v. U.S. Int’l Trade Comm’n.*, 598 F.3d 1294 (Fed. Cir. 2010).

In the case of Api, the only example to use an amine-based polyol (i.e. PLURACOL® 355) failed to function for Api’s intended purpose – to product a flame-retardant foam. The working examples, Examples 1-6, do not use an amine-based polyol, or an amine-based polyol that is EO free. One skilled in the art, considering all of the possible combinations of components, would not have the motivation or reason to particularly select at least 40 parts by weight of PO-extended *triethanolamine*-based polyether polyol as claimed. The fact that triethanolamine is mentioned as a possible component for any of Api’s three reactive

components, along with any other known polyol, cannot be enough to render the claimed foam obvious. If this were the case, all polyurethane foams would be rendered obvious by Api since its disclosure broadly lists any polyol and other components, in any weight percents, and any combination thereof. Such a disclosure cannot render obvious the use of a particular polyol in a specific amount for use in a foam suited for a different purpose than the applied reference.

Moreover, the claimed foam yields more than a predictable result, and Api does not fairly teach, when viewed in context of the examples therein, the selection of EO-free triethanolamine in an amount of at least 40 weight percent. Rather, the only instruction as to amine-based polyols Api provides, other than broadly listing all possible components, is that amine-based polyols fail to provide a flame-retardant foam – the entire thrust of Api’s teaching. Such contradictory evidence, as opposed to merely a general teaching, would not suggest or motivate one skilled in the art to arrive at the claimed foam composition, or even to suspect such a foam would have desirable force attenuation properties as discussed above; properties that are never mentioned in the cited reference.

In view of the inventor’s declaration of unexpected and surprising results, coupled with Api’s laundry-listing approach to teach a flexible, flame-retardant foam, which is diminished by its own failed example, Api does not render claim 68 obvious. The present rejections unfairly infer that Api’s broad disclosure of components is instructive to one skilled in the art as to all of the possible combinations of components to achieve all possible properties or combinations of properties for a polyurethane foam. The rejections further do not reasonably consider the unpredictable nature of the chemical foam arts, which is expressed in the Api reference itself. Accordingly, in view of the foregoing, applicant respectfully requests that the obviousness rejection of claim 68 be reversed.

***B. Claims 66-67 satisfy the requirements of 35 U.S.C. § 112***

Applicant submits that claims 66-67 contain subject matter that was clearly described in the specification in such a way as to reasonably convey and enable one skilled in the art to make and use the claimed invention. The current final rejection specifically rejects the claimed impact properties and indicated recoverability (i.e. “about” 100 g’s of breakthrough acceleration and substantially 100% recoverable) as new matter that is not described in the specification.

The new matter rejection directly stems from applicant’s amendment to the specification at paragraph [0048] on December 17, 2008, which also is objected to in the current final rejection. The applicant believes that the originally-filed specification and Figures, separate from the objected amendments to paragraph [0048], provide adequate support such that claims 66 and 67 satisfy the requirements of 35 U.S.C. § 112, first paragraph. The rejection of claims 66 and 67 is addressed below without reference to the present objection to the amendments of paragraph [0048], which the Board is not required to consider. Applicant respectfully submits, however, that said objection is also overcome by the following argumentation and will, if necessary, be addressed by a petition to the Director.

***Independent claim 66***

Claim 66 recites, in part, a semi-rigid foam that exhibits “about” 100 g’s of breakthrough acceleration upon impact with a 4-inch flat circular impactor at 2 m/s, wherein the semi-rigid foam is substantially 100% recoverable. The Examples section of the specification and corresponding Figure 1 provide a description of the claimed foam. Table 2 discloses 8 foam formulations prepared according to the invention (p. 13). In Example 2, the impact and



recoverability properties of Foam No. 2, one of the 8 foams, was compared to conventional expanded polystyrene (EPS) foam by separately subjecting Foam No. 2 and EPS foam to impacts from a 4-inch flat circular impactor at a range of impact velocities from 2 to about 6.5 m/s (p. 15, [0048]). Figures 1 and 2 graphically show the results of the impact tests with the 4-inch flat circular impactor. Figure 1 clearly shows that Foam No. 2 exhibits about 100 g's of breakthrough acceleration at an impact velocity of 2 m/s. That is, the dotted plot line representing the claimed foam intersects about the 100 g's mark on the y-axis at 2 m/s.

Notably, drawings may provide an adequate written description of a claimed invention. See *In re Wolfensperger*, 302 F.2d 950, 133 USPQ 537 (CCPA 1962). As noted above, paragraph [0048] as originally filed discloses that Foam No. 2 was impact tested at a velocity of 2 m/s, and thus one skilled in the art viewing Figure 1, coupled with the as-filed specification, would not only understand that Foam No. 2 exhibits about 100 g's of breakthrough acceleration at 2 m/s as claimed, but also would know the composition of such a foam and a method of making the same as described in the specification. With regard to recoverability, it is further noted in the specification that the same foam, Foam No. 2, recovered to substantially 100% of its initial volume and shape after impact testing with a 4-inch flat circular impactor at velocities from 2 to about 6.5 m/s (p. 16, [0048] as-filed).

It is stated in the current final rejection that the originally-filed supporting disclosure, including the figures, does not provide support for the specific values or ranges of values (i.e. "about") encompassed by claims 66 and 67. However, as noted above, claim 66 recites the properties and test conditions that are described in and graphically show in the specification of the originally-filed application.

With regard to "about," that term is used to indicate the breakthrough acceleration as

graphically shown. Applicant submits that Figure 1 adequately supports the use of the word “about” based on the graphical data. Applicant further submits that the term “about” does not generally render a claim indefinite, but merely relaxes the precision of the claimed value as is appropriate for a value derived from graphical data. This is clearly understood by those skilled in the art when encountering the term “about” because it provides a clear indication that exactitude is not being claimed. “About” 100 g’s is sufficiently precise to be definite in the art of measuring breakthrough acceleration. It reasonably quantifies the relevant property of the claimed foam and it is sufficiently clear to apprise a person skilled in the art of the scope of the claimed invention. One skilled in the art of foams would understand that “about” is not an arbitrary term, but rather a word with a meaning similar to “approximately” that indicates an absence of absolute precision in a numerical value. Courts and the USPTO have long recognized that “about” does not generally render a claim indefinite. See *W.L. Gore & Assocs. v. Garlock, Inc.*, 721 F.2d 1540, 1557 (Fed. Cir. 1983), cert. denied.

It is further stated in the current final rejection that because only one foam (i.e. Foam No. 2) was impact tested of the eight prepared foams claim 66 cannot cover any foam except Foam No. 2. The applicant is not required to test all eight foams to prove that each foam sample exhibits the properties of claim 66. Applicant has presented an example demonstrating he was in possession of the claimed invention, and has clearly laid out the test procedure for determining whether a foam sample meets the claim limitations, along with specific foam composition that does. One skilled in the art would no doubt understand that the applicant was in possession of the claimed foam, and such a person also would be equipped with a composition for making such a foam and the method to confirm that it meets the claimed limitations. Accordingly, applicant respectfully submits that claim 66 is sufficiently described in the application as to reasonably

convey to one skilled in the art that the inventor, at the time the application was filed, had possession of the claimed invention.

***Dependent claim 67***

Claim 67 recites the foam of claim 66 except with the further limitation that the foam exhibits about 150 g's of breakthrough acceleration at an impact velocity of 6 m/s. Figure 1 clearly shows the dotted plot line representing the claimed foam crossing the y-axis at about 150 g's at an impact velocity of 6 m/s. One skilled in the art would clearly understand that the claimed foam is supported in the application by viewing Figure 1, and the specification describes the formulation of such a foam and the method of making the same.

With regard to the use of "about" in claim 67, as similarly discussed above with regard to claim 66, this term is not indefinite when used to describe graphical data, and one skilled in the art would understand the meanings with reasonable clarity. Accordingly, applicant respectfully requests that the present rejection of claims 66 and 67 under 35 U.S.C. § 112, first paragraph be overruled.

**CONCLUSION**

For at least the reasons discussed herein, essential elements required to establish a prima facie rejection were omitted; and there exist clear fact and legal deficiencies in the rejections of record. Accordingly, reversal of the present rejections is requested.

Respectfully submitted,  
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Date: December 6, 2010

## CLAIMS APPENDIX

Claims 1-34: Canceled

Claim 35: A semi-rigid viscoelastic foam made from a Part A composition and a Part B composition, said Part A composition comprising 20-50 weight percent isocyanate (NCO), said Part B composition comprising at least 40 parts by weight of one or a mixture of propylene oxide-extended amine-based polyether polyols being at least 3-functional and having an OH number less than or about 150 and having-substantially no ethylene oxide extension units, at least 10 parts by weight of an additional polyol selected from the group consisting of non-amine filled polyether polyols and non-amine unfilled polyether polyols, and 0.01-4 parts by weight catalyst, said Part A and Part B compositions being combined to provide said viscoelastic foam, wherein all values expressed as weight percents are based on the total weight of the Part A composition, and all parts by weight are parts by weight of the Part B composition, said Part B composition having 100 parts by weight total polyols.

Claim 36: A viscoelastic foam according to claim 35, said additional polyol being a tri-functional polyether polyol.

Claim 37: A viscoelastic foam according to claim 35, having an index of 60-115.

Claim 38: Canceled

Claim 39: A viscoelastic foam according to claim 35, said Part B composition further comprising about 1-3 parts by weight water.

Claim 40: A viscoelastic foam according to claim 35, said Part B composition further comprising about 1-6 parts by weight black paste.

Claim 41: A viscoelastic foam according to claim 35, said isocyanate in said Part A composition being present in the form of 4,4'-MDI.

Claim 42: A viscoelastic foam according to claim 41, said 4,4'-MDI being present in said Part A composition in an amount sufficient to provide an isocyanate (NCO) concentration of about 33.6 percent by weight.

Claim 43: A viscoelastic foam according to claim 35, said isocyanate in said Part A composition being present in the form of an allophanate-modified MDI prepolymer, said part A composition having an isocyanate (NCO) concentration of about 20-30 percent by weight.

Claim 44: A viscoelastic foam according to claim 35, said one or a mixture of propylene oxide-extended amine-based polyether polyols comprising monoethanolamine-based polyol in an amount of 0-10 parts by weight, triethanolamine-based polyol in an amount of 40-70 parts by weight, and ethylenediamine based polyol in an amount of 0-36 parts by weight.

Claim 45: A viscoelastic foam according to claim 35, said catalyst comprising amine catalyst in an amount of 0-2.5 parts by weight, delayed action catalyst in an amount of 0-1 parts by weight, and trimerization catalyst in an amount of 0-1 parts by weight.

Claim 46: A viscoelastic foam according to claim 45, said amine catalyst being tertiary amine catalyst, said delayed action catalyst being a combination delayed action catalyst, said trimerization catalyst being a quaternary ammonium salt trimer catalyst.

Claim 47: A viscoelastic foam according to claim 35, said additional polyol being a glycerin-based polyoxypropylene-polyoxyethylene-extended polyether polyol.

Claim 48: A viscoelastic foam according to claim 35, said additional polyol being a polyoxypropylene-polyoxyethylene-extended polyether polyol.

Claim 49: Canceled

Claim 50: Canceled

Claim 51: A viscoelastic foam according to claim 35, said one or a mixture of propylene oxide-extended amine-based polyether polyols comprising triethanolamine-based polyol in an amount of 60 or 70 parts by weight, said additional polyol being present in an amount of 30 or 40 parts by weight.

Claim 52: A viscoelastic foam according to claim 51, said one or a mixture of propylene oxide-extended amine-based polyether polyols further comprising monoethanolamine-based polyol in

an amount of 8-10 parts by weight.

Claim 53: A viscoelastic foam according to claim 51, said additional polyol being a filled polyether polyol.

Claim 54: A method of making a semi-rigid viscoelastic foam comprising the steps of:

- a) providing a Part A composition comprising 20-50 weight percent isocyanate;
- b) providing a Part B composition comprising at least 40 parts by weight of one or a mixture of propylene oxide-extended amine-based polyether polyols being at least 3-functional and having an OH number less than or about 150 and having substantially no ethylene oxide extension units, at least 10 parts by weight of an additional polyol selected from the group consisting of non-amine filled polyether polyols and non-amine\_unfilled polyether polyols, and 0.01-4 parts by weight catalyst; and

- c) combining said Part A and Part B compositions to provide said semi-rigid viscoelastic foam;

wherein all values expressed as weight percents are based on the total weight of the Part A composition, and all parts by weight are parts by weight of the Part B composition, said Part B composition having 100 parts by weight total polyols.

Claim 55: A method according to claim 54, said additional polyol being a tri-functional polyether polyol.

Claim 56: A method according to claim 54, said viscoelastic foam having an index of 60-115.

Claim 57: A method according to claim 54, said Part B composition further comprising about 1-3 parts by weight water.

Claim 58: A method according to claim 54, said Part B composition further comprising about 1-6 parts by weight black paste.

Claim 59: A method according to claim 54, said isocyanate in said Part A composition being present in the form of 4,4'-MDI.

Claim 60: A method according to claim 59, said 4,4'-MDI being present in said Part A composition an amount sufficient to provide an isocyanate (NCO) concentration of about 33.6

percent by weight in said Part A composition.

Claim 61: A method according to claim 54, said isocyanate in said Part A composition being present in the form of an allophanate-modified MDI prepolymer.

Claim 62: A method according to claim 54, said one or a mixture of propylene oxide-extended amine-based polyether polyols comprising monoethanolamine based polyol in an amount of 0-10 parts by weight, triethanolamine based polyol in an amount of 40-70 parts by weight; and ethylenediamine based polyol in an amount of 0-36 parts by weight.

Claim 63: A viscoelastic foam according to claim 35, said one or a mixture of propylene oxide-extended amine-based polyether polyols comprising triethanolamine-based polyol in an amount of 60 or 70 parts by weight, said additional polyol being present in an amount of 30 or 40 parts by weight.

Claim 64: A viscoelastic foam according to claim 63, said one or a mixture of propylene oxide-extended amine-based polyether polyols further comprising monoethanolamine-based polyol in an amount of 8-10 parts by weight.

Claim 65: A method according to claim 63, said additional polyol being a polyoxypropylene-polyoxyethylene-extended filled polyether polyol.

Claim 66: A foam, said foam being a semi-rigid viscoelastic foam, wherein on impact with a flat circular impactor having a 4-inch diameter at an impact speed of 2 meters per second, a sample of said foam measuring 5.5" x 5.5" x 1" thick exhibits about 100 g's of breakthrough acceleration, and wherein said foam sample is substantially 100% recoverable following said 2 m/s impact.

Claim 67: A foam according to claim 66, wherein on impact with said flat circular impactor having a 4-inch diameter at an impact speed of 6 meters per second, said foam sample measuring 5.5" x 5.5" x 1" thick exhibits about 150 g's of breakthrough acceleration, and wherein said foam sample is substantially 100% recoverable following said 6 m/s impact.

Claim 68: A viscoelastic foam made from a Part A composition and a Part B composition, said Part A composition comprising 20-50 weight percent isocyanate (NCO), said Part B composition



comprising at least 40 parts by weight of propylene oxide-extended triethanolamine-based polyether polyol having an OH number less than or about 150 and having substantially no ethylene oxide extension units, at least 10 parts by weight of an additional polyol selected from the group consisting of non-anime filled polyether polyols and non-amine unfilled polyether polyols, and 0.01-4 parts by weight catalyst, said Part A and Part B compositions being combined to provide said viscoelastic foam, wherein all values expressed as weight percents are based on the total weight of the Part A composition, and all parts by weight are parts by weight of the Part B composition, said Part B composition having 100 parts by weight total polyols.

**EVIDENCE APPENDIX**

Exhibit 1: Declaration of Charles M. Milliren, Ph.D., submitted with applicant's response of December 17, 2008 to the Office action dated September 17, 2008 (see pg. 18 of applicant's response).

Exhibit 2: BASF polyol product list for PLURACOL<sup>®</sup> product line.

## **EXHIBIT 1**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Appl. No.	:	10/576,033
Applicant	:	Milliren, Charles M.
Filed	:	April 14, 2006
Title	:	VISCOELASTIC FOAM LAYER AND COMPOSITION
Examiner	:	John M. Cooney
Docket No.	:	36211US1
Customer No.	:	000116

**DECLARATION OF CHARLES M. MILLIREN, Ph.D.**

Charles M. Milliren, Ph.D., having knowledge of the facts set forth herein, declares as follows:

1. I am the named inventor of the present patent application.
2. I presently reside at 12589 Harold Drive, Chesterland, OH 44026.
3. I received a Bachelor of Science in Chemistry from Ursinus College, Collegeville, PA in 1969. I received a Ph.D. in Organic Chemistry from the University of North Carolina at Chapel Hill, North Carolina in 1975.
4. Following my formal education, I was employed by Mobay Chemical Corporation/Miles Inc., Pittsburgh, Pennsylvania, as a research scientist from 1976 to 1991. Subsequently I worked for Bayer Corporation USA in Pittsburgh, Pennsylvania, also as a research scientist, from 1991 to 2001. From 2002 till the present I have been employed by Team Wendy, LLC (f/k/a Coit Road Incubator), Cleveland Ohio and engaged primarily in the research, development and testing of foams for energy absorption applications. Team Wendy, LLC is a related company to Intellectual Property Holdings, LLC, the assignee of the present application.
5. I am an expert in foam chemistry, particularly polyurethane foam chemistry and morphology, with over 30 years of professional research and

development experience. I have authored or co-authored several publications in the field of polyurethane foam chemistry and morphology, a partial list of which is attached hereto as Attachment A.

6. I also am an inventor or co-inventor of numerous U.S. patents relating to polyurethane foam chemistry and morphology, which are listed in Attachment B.

7. I have reviewed the Office action dated December 17, 2008.

8. The specific chemical components that go into a polyurethane foam are outcome-determinative for the physical and behavioral characteristics for the resulting foam. In addition to polyol(s), polyurethane foam formulations may include blowing agent(s), catalyst(s), chain extender(s), crosslinker(s), pigment(s), surface active agent(s), filler(s), flame retardant(s), etc., and polyisocyanate(s). Each component can affect the characteristics of the final foam in an unpredictable way based on its effect on the foam's morphology and physico-chemical structure, which cannot be specified a priori. In general, the polyols used in polyurethane foams can be polyether or polyester types. For polyether foams the initiator molecule and the alkyleneoxides (e.g. ethylene oxide [EO] and polyethylene oxide [PO]) used for chain extension are extremely important in determining the solubility, compatibility, reactivity, surface tension, stability and function of the reacting polyol. The alkyleneoxides (EO, PO) make an important contribution toward determining the physical characteristics of the resulting polyurethane foam, i.e., the foam's morphology, which is largely determined by the molecular weight, structure and reactivity of the polyol(s) in addition to other factors. The morphology determines the type and amount of important physical interactions in the resulting foam, which contribute to the foam's rigidity.

9. Ethylene oxide extension units in a polyol tend to increase the flexibility (decrease the rigidity) of a polyurethane foam because EO extension produces a regular linear structure with a higher number of degrees of freedom than does extension by propylene oxide (PO). Conversely, propylene oxide extension units tend to decrease foam flexibility (increase rigidity) because of a reduced number of degrees of freedom. This is due to the pendant methyl groups present in PO-extended polyols, which are not

present in EO extension units or in exclusively EO-extended polyols. Therefore, a polyurethane foam made from a substantial proportion of amine-based polyols (which are typically used to produce rigid foams), that are propylene-oxide extended and have substantially no ethylene oxide extension units, would be expected to be quite a rigid foam, having a much reduced degree of flexibility. Such a foam certainly would not be expected to exhibit a flexible recovery following a deflection.

10. However, very surprisingly, it has been found that substantially fully-recoverable semi-rigid viscoelastic foams can be prepared using in the 'Part B' composition for making polyurethane foam a substantial proportion (at least 10 parts by weight out of 100 parts by weight total polyols) of amine-based polyether polyols that are propylene-oxide extended and have substantially no ethylene oxide extension units.

11. Regarding the references cited by the examiner, none of them discloses or even remotely suggests a semi-rigid, recoverable viscoelastic foam. Certainly none of them discloses achieving such a polyurethane foam using the substantial proportion of amine-based polyether polyol recited in the independent claims of the present application, which are propylene-oxide extended and have substantially no ethylene oxide extension units.

12. First, the foams in Apichatachutapan are soft foams, not semi-rigid foams, as evidenced by the data presented in the Examples of Apichatachutapan. Specifically, the foams in this reference have been tested for physical properties characteristic of soft flexible foams (25% and 65% IFD, sag factor) and the resulting data are typical of such foams; see Table 2 in Apichatachutapan. Conversely, the "semi-rigid" foams as claimed in the present application could not be tested for IFD or sag at least because they are too rigid to fall within the property limits of soft flexible foams. On the other hand, the present application presents extensive data for semi-rigid foams showing energy absorption characteristics at various dynamic impact speeds. Dynamic impact testing is totally unsuitable for flexible foams as in Apichatachutapan because such foams do not exhibit any appreciable degree of dynamic impact energy attenuation and would be instantaneously completely compressed (they would bottom out) with no

energy absorption to speak of. Apichatachutapan is concerned primarily with providing a high density flexible foam that exhibits flame retardant properties without the incorporation of any separate flame retardant additive (see para. [0002] and rest of application). No mention or hint of energy absorption properties, particularly against a dynamic impact, (and hence no suggestion to prepare a semi-rigid foam) is to be found in Apichatachutapan.

13. Regarding Lutter, the foams in this reference are soft, flexible foams (see col. 4, line 45 and col. 8, line 50) which are completely different from the semi-rigid foams described in the present application. Lutter does not disclose or discuss dynamic impact properties for the foams therein, because soft, flexible foams are unsuited for this purpose. Again, no reason to prepare a foam having energy-absorptive properties is evident.

14. Likewise, Falke describes only flexible polyurethane foams (col. 1, line 5) designed primarily as sound absorbers in carpet backing (col. 1 and col. 2) with a loss factor (col., line 40) greater than 0.3. Falke does not discuss or show any dynamic impact properties for the disclosed flexible foams, principally because such foams are totally unsatisfactory for dynamic impact attenuation.

15. Conversely, the semi-rigid viscoelastic foams now claimed are directly suited for dynamic impact attenuation applications as evidenced by the substantial dynamic impact test data provided in the specification. There would be no reason to make, or even to expect one could make, a semi-rigid foam falling within the scope of the present claims based on the teachings of any of the cited references, in particular because all of them disclose flexible foams and none of them even hints at a semi-rigid foam or at any application, such as dynamic impact energy attenuation, that calls for a semi-rigid foam.

16. The present invention is based on the extremely surprising result that the combination of a substantial amount of an amine-based polyether polyol, or a mixture of such polyols, that is/are propylene oxide extended, together with at least one other filled and/or unfilled polyether polyol and an appropriate amount of isocyanate, produces a

semi-rigid viscoelastic foam that has proven very effective to attenuate impact force across a very wide range of dynamic impact speeds; e.g. ranging from 2-6 meters per second, or broader, and is also recoverable after impact. This result was particularly surprising because amine-based polyols are usually considered to be rigid foam precursors, and it was quite surprising that the use of such polyols, in relatively significant amounts with other polyols, and particularly having substantially no ethylene oxide extension units, would produce such effective semi-rigid foams that are so well suited to dynamic impact energy attenuation applications, yet still recover following an impact. Even more surprising was the breadth of impact speeds over which impact force could be effectively attenuated using these foams compared to a conventional rigid foam such as EPS, as seen in the Examples in the application and discussed below.

17. It was particularly surprising that amine-based polyols having substantially no ethylene oxide extension units would produce such an effective semi-rigid and recoverable viscoelastic polyurethane foam because EO extension is usually employed in semi-rigid foams to provide a requisite degree of flexibility compared to rigid, non-recoverable foams. In addition, EO extension helps contribute sufficient reactivity to the polyol to produce a stable foam morphology (structure) in the resultant semi-rigid foam, and produces excellent cure characteristics generally desired of semi-rigid foams. A recoverable, semi-rigid viscoelastic foam based on at least 10 parts by weight propylene oxide-extended amine-based polyol having substantially no ethylene oxide extension units was very surprising.

18. Example 1 in the application describes eight different foams all made according to compositions of propylene oxide extended amine-based polyols (having no ethylene oxide extension units) with filled and unfilled (trifunctional, glycerin based) polyols as claimed. Table 3 of that Example shows that all eight of these foams performed comparably to conventional expanded polystyrene (EPS), which is the conventional rigid foam used in bicycle helmets to attenuate high speed impacts, for an



impact velocity of nominally 6.23 meters/second<sup>1</sup>. In fact, six of the eight foam formulations tested actually exhibited lower peak g-values (breakthrough acceleration values) than EPS. This was a very highly surprising and unexpected result for a semi-rigid viscoelastic foam that substantially recovered following each impact. Further surprising was the fact that mixtures of two and three amine-based polyether polyols in the compositions in Example 1 (Table 2), all of which contained substantially no ethylene oxide extension units, produced foams that nonetheless substantially recovered following impact as seen in the example.

19. Example 2 and Figs. 1-12 demonstrate further the ability of an exemplary semi-rigid viscoelastic foam according to the invention, Foam No. 2 from table 2, to adequately and effectively attenuate dynamic impacts of low (2 meters/second) to high (6 meters per second and beyond) compared to conventional EPS. As the data demonstrate, EPS is far less effective than the foams of the invention to attenuate low speed impacts because of its substantial rigidity. In addition, EPS, being a rigid foam, is irreversibly and destructively crushed on impact of sufficient force and thus did not recover and could not be reused. Conversely, the foams according to the invention, being semi-rigid and viscoelastic, were effective to attenuate a wide range of impact forces and did recover substantially, permitting their reuse for multiple impacts.

20. The combination of these widely differing yet highly desirable properties:
- semi-rigid foam exhibiting comparable performance to EPS following high-speed impact (6.23 m/s) using a rigid spherical or circular impactor under the conditions disclosed in the specification;
  - viscoelastic foam that behaves comparably to a flexible foam for relatively low-speed impacts (e.g. 2 m/s) using the impactors and conditions disclosed in the specification;
  - a foam that substantially recovers following high speed impact;

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<sup>1</sup> Conventional EPS is the closest prior art to the present foams, which provide impact protection comparable to EPS for high-speed impacts at 6.23 m/s under the conditions described in the Examples. However, unlike EPS, the present foams are recoverable and can be reused, and also provide a measure of impact protection at lower speeds (e.g. 2 m/s). At such low speeds, impact force is substantially transmitted through EPS, thereby providing little or no impact protection at all.

- a foam that following recovery, exhibits negligible loss in strength and its ability to absorb another high-speed impact (6.23 m/s) using the impactors and conditions disclosed in the specification;

in a single foam that incorporates a substantial proportion ( $\geq 0$  parts by weight, out of a total of 100 parts by weight) of amine-based polyether polyols that are propylene-oxide extended and have substantially no ethylene oxide extension units, was an incredibly surprising and unexpected result, **which could not have been predicted a priori** by a person having ordinary skill in the art who has had placed in front of him every conceivable species of isocyanate, polyol initiator, polyol extension unit, catalyst, filler, etc. that has ever been used or could be used to prepare any polyurethane foam, with no guidance how to combine them or in what proportions, or even what the properties of the ultimate foam should be.

21. A person having ordinary skill in the art certainly would not have expected to achieve a polyurethane foam having the properties recited above, using the proportion of amine-based, propylene-oxide extended polyol, having substantially no ethylene oxide extension units, in the Part B composition for a polyurethane foam as recited in claims 35 and 54 of the present application.

22. Nothing in the prior art references suggests the combination of an amine-based polyether polyol(s), which are very reactive and typically used for rigid foams, with the filled and/or unfilled polyols as claimed to produce a semi-rigid viscoelastic foam exhibiting the aforementioned properties. Furthermore, nothing in the prior art suggests the amine-based polyol(s) should be propylene oxide extended and have substantially no ethylene oxide extension units as in the claimed formulations. The combination of these components to produce the semi-rigid viscoelastic foam having the properties described above truly was a very surprising and unexpected result that could not have been predicted *a priori* based on selection of polyols and/or other reagents for the foam compositions. Certainly, there would have been no expectation of success, starting from any of the cited references, to produce a semi-rigid viscoelastic foam as claimed based significantly on propylene oxide extended amine-based polyols, at least because all those references are directed to flexible foams and no reason is

provided or evident in any of them why or how amine-based polyols can be used to provide an effective semi-rigid viscoelastic foam.

23. I have carefully and thoroughly reviewed the Apichatachutapan, Lutter and Falke references applied by the Examiner. As an expert in polyurethane chemistry with over thirty years of professional research experience in the field, the vast disclosures of literally tens of different species for each class of compound typically found or that can be incorporated in a polyurethane foam provides no special motivation or suggestion to select particular ones of each said class to combine them in any other way than the respective references actually did. In the references, there is no combination whatsoever incorporating the proportion and chemistry of the amine-based polyether polyols as presently claimed. And rightfully so, as these references all describe flexible foams. None of these references presents any reason or motivation to produce the formulation as now recited in either the independent claims 35 and 54 in the present application. Nor would any reason to select the particular compositions there claimed be evident to the skilled artisan in view of those references, at least because:

- a) one would not expect to obtain a recoverable semi-rigid viscoelastic foam using the proportion of propylene-oxide extended amine-based polyether polyols having substantially no ethylene oxide extension units as claimed; and
- b) the vast laundry lists of tens of species for each general class of components that can make up a polyurethane foam, as found in the references, do not suggest to the skilled artisan any particular foam formulation, for any purpose, based on knowledge one could reasonably expect the ordinarily-skilled artisan to possess.

24. In addition, the reason proposed by the Examiner to suggest it would have been obvious to use amine-based polyols in any of the three cited references is incorrect. In connection with all three references, the Examiner stated in the Office action that it would have been obvious to substitute amine initiators (resulting in amine-based polyols) for the initiators actually used "for the purpose of providing their isocyanate reactive effect in the preparations of [the reference] in order to arrive at the products...of applicants' claims...." It is true that amine initiators result in highly reactive

polyols. This produces foams with high degrees of cross-linking compared to foams produced using polyols based on other initiators, e.g. glycerin. Higher cross-linking rates typically result in much stiffer, more rigid foams as known in the art. Therefore, the high reactivity of amine-based polyols cited by the Examiner is actually a reason not to use them in any of the references (certainly in the proportions claimed), which all clearly are directed to flexible or soft foams as noted above. In addition, the high reactivity of amine-based polyols also makes them a unlikely candidate to produce the semi-rigid viscoelastic foams that are now claimed, which are recoverable after deformation. As already explained, it was highly unexpected that a foam formulation containing the proportion of amine-based (reactive) polyols as required in the claims would yield a foam that is not only viscoelastic, but that substantially recovers following deformation and can be reused. A person of ordinary skill in the art would not expect this result based on using amine-based polyols in the claimed proportions (certainly not ones having substantially no ethylene oxide extension units), and therefore would have had no expectation of success to achieve the recoverable semi-rigid viscoelastic foam that is claimed.

25. Finally, although the references mention amine initiators, any person of ordinary skill in the art would recognize that all of them are directed to flexible foams, and that the mention of amine initiators and numerous other ingredients that might be used to make all kinds of polyurethane foams was mere laundry-listing of every potential ingredient the writer could think of, without any consideration whether or how to select any subset or combination of them to produce a particular foam. A person of ordinary skill in the art would not be led to use the amine-based polyols now claimed, particularly having substantially no ethylene oxide extension units as claimed, to make *either* any foam disclosed in Lutter, Falke or Apichutachatapan, or any foam of the present claims. To prepare the present recoverable, semi-rigid viscoelastic foams, I initially had all of these potential ingredients at my disposal, and I undertook exhaustive experimentation to develop a foam having the target properties. As noted above I have over thirty years of experience in research and development of polyurethane foams. I could not possibly have guessed at the outset that a foam composition made from a 'part B' composition, as known in the art, having at least 10 parts by weight (out of 100

parts by weight total polyol) propylene oxide-extended amine-based polyether polyol with substantially no ethylene oxide extension units, would produce the semi-rigid, viscoelastic and recoverable foam I had hoped to produce. That was a surprising and unexpected result based on my over thirty years of professional experience, which no person of ordinary skill in this art could have predicted *a priori*, or would have found obvious from the lists of potential ingredients in Lutter, Falke or Apichutachatapan.

26. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.



Charles M. Milliren, Ph.D.

12/17/2008

Date

**ATTACHMENT A:**  
**List of Relevant Publications**

1. 33<sup>RD</sup> Polyurethanes Technical/Marketing Conference, Sept. 30-Oct. 3, 1990, pp 28-31, A New MDI Foam Technology for Seating and Headrest Applications.
2. *Plastics Engineering*, Jan. 1991, page 23, "A New Non-CFC, MDI Based Flexible Foam Technology."
3. Polyurethanes Expo 99, Sept. 12-15, 1999, pp. 151-161, "Low Compression Set – High Elongation: A Paradox?"
4. Paper by Orbseal LLC and Bayer Corporation, Oct. 1, 2001, New PU Cavity Filling Foam for Sound Abatement in Car Body Shells.

**ATTACHMENT B:**  
**List of U.S. Patents of which I am Inventor or Co-Inventor**

1. 4,876,292 - Isocyanate reactive mixture and the use thereof in the manufacture of flexible polyurethane foams
2. 5,028,637 - Isocyanate reactive mixture and the use thereof in the manufacture of flexible polyurethane foams
3. 5,252,624 - System for the production of toluene diisocyanate based flexible foams and the flexible foams produced therefrom
4. 5,405,886 - System for the production of toluene diisocyanate based flexible foams and the flexible foams produced therefrom 5,415,802 Water Blown, Energy Absorbing Foams
5. 5,417,880 - Water blown, energy absorbing foams
6. 5,449,700 - Water blown, energy absorbing foams
7. 5,457,137 - Water blown, energy absorbing foams
8. 5,874,485 - Flexible foams and flexible molded foams based on allophanate-modified diphenylmethane diisocyanates and processes for the production of these foams
9. 6,235,138 - Polyurethane foam/PVC laminate for automotive instrument panels

## **EXHIBIT 2**





» BASF Home

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» Isocyanates Product Line

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## Polyol Product List

### CASE Polyols

Products	Nom. Func.	OH No. (avg.)	Nom. MW.	Viscosity cps @ 25C	Initiator	EQ cap	Acid No. (max.)	Na&K ppm (max.)	MSDS
Pluracol P410R	2	265	400	73	diol glycol	None	0.01	10	MSDS
Pluracol P710R	2	145	700	130	diol glycol	None	0.01	5	MSDS
Pluracol P1010	2	107	1000	150	diol glycol	None	0.04	5	MSDS
Pluracol 1477	2	56	2000	470	diol glycol	Yes	0.01	5	MSDS
Pluracol P2010	2	56	2000	250	diol glycol	None	0.035	5	MSDS
Pluracol 1044	2	29	4000	790	diol glycol	None	0.01	5	MSDS
Pluracol 1062	2	29	4000	850	diol glycol	Yes	0.01	5	MSDS
Pluracol 628	2	25	4500	1100	diol glycol	Yes	0.01	5	MSDS
Pluracol 888	3	935	180	1360	triol glycol	None	0.01	5	MSDS
Pluracol TP440	3	413	400	600	triol glycol	None	0.03	10	MSDS
Pluracol GP430	3	398	400	360	triol glycol	None	0.05	15	MSDS
Pluracol GP730	3	230	700	270	triol glycol	None	0.03	10	MSDS
Pluracol TP740	3	230	700	325	triol glycol	None	0.04	10	MSDS
Pluracol 1135i	3	112	1500	300	triol glycol	None	0.01	5	MSDS
Pluracol TP2540	3	65	2500	400	triol glycol	None	0.04	7	MSDS
Pluracol 726	3	58	3000	420	triol glycol	None	0.015	5	MSDS
Pluracol 1718	3	58	3000	560	triol glycol	Yes	0.01	5	MSDS
Pluracol 1388	3	56	3000	503	triol glycol	Yes	0.01	5	MSDS
Pluracol 1385	3	50	3200	565	triol glycol	Yes	0.01	5	MSDS
Pluracol 593	3	46	3650	1340	triol glycol	Yes	0.05	2	MSDS
Pluracol TPE 4542	3	37	4500	900	triol glycol	Yes	0.04	5	MSDS
Pluracol 220	3	27	6000	1300	triol glycol	Yes	0.06	8	MSDS
Pluracol 360	3	25	6500	1400	triol glycol	Yes	0.01	5	MSDS
Pluracol 1123	3	24	7000	2580	triol glycol	Yes	0.01	5	MSDS
Pluracol 538	3	35	4800	875	triol glycol	Yes	0.01	5	MSDS
Pluracol 816	3	35	4800	900	triol glycol	Yes	0.01	5	MSDS
Pluracol	3	35	4800	900	triol glycol	Yes	0.01	5	MSDS

945

Pluracol 2090	3	28	5500	950	triol glycol	Yes	0.01	5	MSDS
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Pluracol 1026	3	27	6000	1320	triol glycol	Yes	0.01	5	MSDS
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Quadrol®	4	770	292	53000	amine	None	-	-	MSDS
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Pluracol PEP450	4	555	400	2000	tetrol glycol	None	0.06	15	MSDS
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Pluracol PEP550	4	450	500	1600	tetrol glycol	None	0.06	15	MSDS
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Pluracol 365	4	450	500	2700	amine	None	-	-	MSDS
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#### Graft Slab Polyols

Products	Foam Category	OH No. (avg.)	% Solids	Viscosity cps @ 25C	EO cap	Acid No. (max.)	MSDS
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Pluracol 1365 (Graft)	Thermo-formable	69	50	3750	None	0.01	MSDS
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Pluracol 4600 (Graft)	Slab	30	44	4000	None	0.01	MSDS
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Pluracol 4815 (Graft)	Molded	26	15	1820	Yes	0.015	MSDS
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Pluracol 4830 (Graft)	Molded	26	30	2950	Yes	0.015	MSDS
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Pluracol 4890 (Graft)	Molded	20	45	2950	Yes	0.015	MSDS
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#### Rigid Polyols

Products	Nom. Func.	OH No. (avg.)	Nom. MW.	Viscosity cps @ 25C	Initiator	EO cap	Acid No. (max.)	Na&K ppm (max.)	MSDS
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Pluracol 922	4	500	445	17200	amine	Yes	-	-	MSDS
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Pluracol 738	4	450	500	5500	amine	Yes	-	-	MSDS
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Pluracol 736	4	380	550	14500	sugar	None	-	-	MSDS
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Pluracol 824	4	380	570	10500	amine	Yes	-	-	MSDS
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Pluracol SG-360	4.5	368	610	3500	sugar/gly	None	-	-	MSDS
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**RELATED PROCEEDINGS APPENDIX**

There are no related proceedings.